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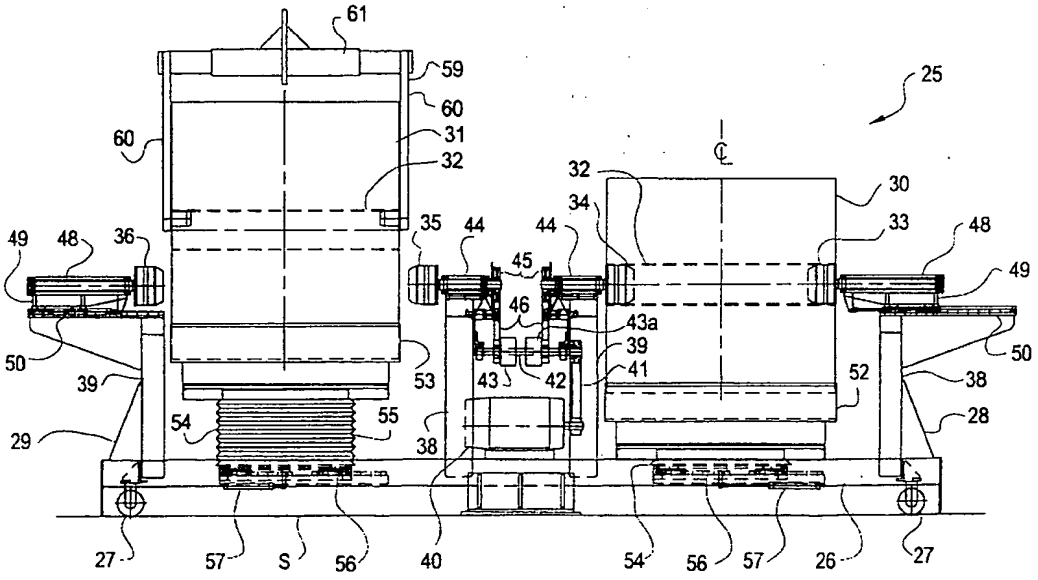
(54) Center driven side shuttle unwinder

(57) A side-shuttle unwinder supports a pair of parent rolls which are alternately rotated to unwind a web. Each of the parent rolls is engageable with a center drive mechanism for rotating the parent roll. Each center drive mechanism can include core chucks which are removably engageable with the parent roll. The core chucks can be permanently or rotatably mounted on the side shuttle.

FIG.1



EP 1 136 406 A2

Description

Background of the Invention

[0001] This invention relates to an unwinder for a roll of web material, and, more particularly, to an unwinder which includes a side shuttle support for a pair of parent rolls which are alternately unwound by a center drive mechanism.

[0002] Unwinders are commonly used to unwind a roll of wound web material so that the web can be processed by equipment downstream of the unwinder. For example, in the paper converting field a large parent roll of paper is unwound and advanced to a rewinder, which perforates the paper to form individual sheets and rewinds the paper into consumer-sized logs or rolls of bathroom tissue or paper towels. Examples of such rewinders are described in U. S. Patent Nos. Re. 28,353, 4,723,724, 5,104,055 and EPO Patent No. 0 694 020 B1.

[0003] When a parent roll is completely unwound or almost completely unwound, or when it is desired to change the parent roll for any other reason, the parent roll must be removed from the unwinder and replaced with a new roll. The leading end of the new roll must be joined or spliced to the trailing end of the old roll so that a continuous web is advanced through the downstream equipment.

[0004] U. S. Patent Nos. 5,906,333 and 5,934,604 describe a center drive unwinder which automatically replaces parent rolls and splices the trailing end of the old roll and the leading end of the new roll.

[0005] Many unwinders are not center driven. Instead, the roll is rotatably mounted on the unwinder, and a belt driven mechanism engages the surfaces of the roll to rotate the roll and unwind the web.

[0006] U. S. Patent No. 5,730,389 describes a device for changing and splicing rolls on a belt-driven unwinder. Two rolls are mounted on movable carriages. The first roll is unwound by the belt, and the second roll is laterally offset from the first roll. The leading end of the second roll is retained by a suction member on the carriage. When the rolls are to be changed, a second suction member and a blade are moved against the web to cut the web and hold the trailing end of the web against the second suction member. The second suction member and the blade are then moved away from the web path. The carriages are moved to bring the second roll into the unwinding position, and the leading end of the second roll is joined to the trailing end of the first roll.

[0007] U.S. patent application entitled "Automatic Splicer for Unwinder", Serial No. 09/216,323, filed December 18, 1998, describes an improved device for automatically changing and splicing rolls on a belt-driven unwinder. That patent application and this application are owned by the same assignee.

Summary of the Invention

[0008] The invention provides a quick change center driven unwinder and removable core chucks for driving a parent roll. First and second parent rolls are mounted on a side shuttle or movable carriage. The carriage may be equipped with a lifting device for each parent roll for assisting in loading and removing the parent rolls. While the first roll is being unwound, the second roll can be mounted on the carriage in readiness for unwinding when the first roll expires. The parent rolls can be driven by a common single motor which alternately drives each parent roll, by one or two motors for each parent roll, or by three motors -- a main drive motor between the parent rolls which is switched back and forth between the parent rolls and separate motors for each parent roll. The core chucks can be permanently mounted on the carriage and connected to the drive mechanism, or the drive mechanism can be connected to the chucks after the chucks are inserted into the core of one of the parent rolls and installed into the carriage.

Description of the Drawing

[0009] The invention will be explained in conjunction with illustrative embodiments shown in the accompanying drawing, in which --

Figure 1 is a front elevational view of a movable carriage or side shuttle for a pair of parent rolls, the carriage being equipped with a lift device and a center drive mechanism for each parent roll;

Figure 2 is a view similar to Figure 1 showing both parent rolls axially aligned with the core chucks, the right parent roll being unwound and the left parent roll in the process of being connected to the core chucks;

Figure 3 illustrates the left parent roll engaged by the core chucks as the right parent roll continues to unwind;

Figure 4 illustrates the left parent roll being prepared for splicing to the web which is being fed to the rewinder from the right parent roll;

Figure 5 illustrates the carriage moved to the right from its position in Figures 1-4 to align the left parent roll with the web in the rewinder after the right parent roll has been unwound;

Figure 6 shows the lift mechanism for the right parent roll about to raise the expired roll and, the left corechuck disengaged from the expired roll, and the expired roll pulled to the right by the chuck so that it can be disengaged;

Figure 7 illustrates both core chucks disengaged from the expired roll and the expired roll raised to a level where it can be engaged by the parent roll loading device;

Figure 8 illustrates the alternate positions of the parent rolls as the axially movable core chuck for each

roll moves to engage or disengage the core with the opposite core chuck and also illustrates using one centrally located drive which switches from right to left parent rolls;

Figure 9 is a view similar to Figure 3 of an alternate embodiment of the invention in whcih each parent roll is driven by a separate motor;

Figure 10 illustrates a two motor configuration in which the motors are located between the parent rolls;

Figure 11 illustrates a three motor configuration, the center motor being alternately connected to the right and left parent rolls;

Figure 12 illustrates a four motor configuration;

Figure 13 is a side elevational view of the side shuttle unwinder and an associated splicing apparatus;

Figure 14 is a view similar to Figure 1 in which core chucks which are removable from the drive mechanism are inserted into the new parent roll and the new parent roll is lifted by hooks which engage the core chucks;

Figure 15 is a fragmentary sectional view of one of the removable core chucks of Figure 14 which is clamped in place on the carriage;

Figure 16 illustrates another embodiment of a removable core chuck;

Figure 17 is a fragmentary side elevational view of a drive mechanism for the removable core chucks;

Figure 18 is a front elevational view of another embodiment in which drive shafts which are permanently mounted on the carriage are engageable with core chucks which are inserted into the core of the parent roll;

Figure 19 is a view similar to Figure 18 in which the right parent roll is being unwound and the left parent roll is being loaded;

Figure 20 is an enlarged fragmentary sectional view of one of the drive shafts and core chucks of Figure 18;

Figure 21 illustrates a drive mechanism for a parent roll which retains the center shaft which is used in the paper machine for winding the web onto the shaft to form the parent roll;

Figure 22 is a view similar to Figure 21 showing the right parent roll being unwound and the left parent roll being installed; and

Figure 23 is an enlarged fragmentary sectional view of the drive mechanism for the parent rolls of Figures 21 and 22.

Description of Specific Embodiments

[0010] Referring to Figures 1-8, an unwinding apparatus 25 includes a carriage 26 which is mounted on rollers 27 for movement on a support surface S. The carriage includes two support frames 28 and 29 for rotatably supporting first and second parent rolls 30 and 31.

[0011] Each parent roll includes a hollow center core 32, and core chucks 33-36 on the support frames can be inserted into the open ends of the cores. Each of the roll support frames includes right and left upwardly extending posts 38 and 39 for rotatably supporting the core chucks.

[0012] In the embodiment of Figures 1-8, the middle core chucks 34 and 35 are driven by a motor 40 which is mounted on the carriage. A drive belt 41 rotates a shaft 42, and rotary motion of the shaft is selectively transferred to one of the core chucks by a clutch 43 or 43a.

[0013] Each of the middle core chucks 34 and 35 includes a shaft 44 which is rotatably mounted on one of the upwardly extending posts in a fixed position. A pulley 45 on the end of the shaft is connected to the shaft 42 by a belt 46.

[0014] Each of the right and left core chucks 33 and 36 includes a shaft 48 which is rotatably mounted on a core chuck carriage 49. Each carriage 49 is slidably mounted on a slide 50 which includes a drive mechanism for axially moving the core chuck toward and away from the parent roll.

[0015] Parent roll lifting platforms 52 and 53 on the support frames are movable between raised and lowered positions by a lift mechanism 54 which is enclosed by a bellows 55. The lift mechanism can be any conventional lift mechanism, for example, the hydraulic lift assembly which is described in U.S. Patent No. 5,934,604 and which includes scissors lift arms and a hydraulic piston. Each lift mechanism is mounted on a slide 56 which enables the lift mechanism to slide in the axial direction of the parent roll. A side shift mechanism 57 on the carriage moves the lift mechanism axially.

[0016] Referring to Figure 1, the right parent roll 30 is located at the centerline of the rewinder or other web handling apparatus. The motor 40 is connected to the core chuck 34 through the clutch 43a to rotate the parent roll 30 and to unwind the web.

[0017] The left parent roll 31 is being loaded onto the carriage by a parent roll loading device 59 which is suspended from a crane. The loading device 59 is conventional and includes a pair of lift arms 60 which are mounted for axial movement in cross tube 61. The left parent roll lift platform 53 is elevated by the lift mechanism 54 to support the parent roll 31 so that the lift arms 60 can be separated and raised without interference from the core chucks 35 and 36.

[0018] In Figure 2 the platform 53 has been lowered so that the core 32 of the parent roll is axially aligned with the core chucks 35 and 36. A sensor can detect the core center and stop the platform when the core is in the correct position. The left core chuck 36 has been moved to the right and is inserted in the core.

[0019] In Figure 3 the left core chuck 36 is moved farther to the right to push the parent roll on the slide 56 so that the right core chuck 35 is inserted into the core. The side shift mechanism 57 can also be used to move the parent roll to the right.

[0020] Each of the core chucks includes conventional expandable core grippers. The core grippers are expanded when the core chucks are inserted into the core so that the parent roll rotates with the chucks.

[0021] In Figure 4 the right parent roll continues to unwind, and the left parent roll is prepared for splicing to the web which will be severed from the right roll. The details of the splicing procedure are described in the aforementioned U. S. Serial No. 09/216,323, filed December 18, 1998.

[0022] On center driven designs using a single drive motor 40, an auxiliary motor can be used to rotate the new parent roll off line for preparing the roll for splicing. Since speed and control are not required for this step, the auxiliary motor could be much smaller than the main drive motor. The high torque and compact size of a hydraulic motor would be ideal for this application.

[0023] In Figure 5, the right parent roll has stopped after it reaches a predetermined diameter. The running web is severed and the carriage 26 has moved to the right so that the prepped parent roll 31 is aligned with the web in the rewinder. The diameter of the running parent roll can be monitored via a laser measuring device or other means such as using a programmable logic controller to calculate diameter using parent roll rpm and line speed. The traversing motion of the parent roll carriage can be controlled automatically also. A sender-receiver photo eye unit 62 can be located on framework off of the carriage so that it is looking between the parent rolls when one parent roll is running. When the new parent roll traverses toward the machine centerline, the beam between the sender and receiver unit is broken, as the parent roll continues past the sender receive location, the beam is seen again. By typing the traversing mechanism to carriage location via an encoder, LVDT, resolver, or spring loaded cable potentiometer, a controller can be used to position the carriage so that it stops at the desired location. The drive power from the motor 40 is transferred by the clutch 43a from the parent roll station that is expired to the parent roll station with the new roll and engaging clutch 43.

[0024] In Figure 6, the parent roll lifting platform 52 is staged just below the expired roll in the unloading position. This can be done manually or the lifting platform can be made to stop via a switch triggered by the core being present near the top of the platform. The core gripping means located on the stationary core chuck 34 is disengaged. The core chuck 33 mounted on the linear slides 50 is actuated such that it pulls the core off of the stationary core chuck. The unsupported end of the core falls onto the parent roll-lifting platform. The core gripping means on the core chuck 33 on the linear slide disengages from the core. The other end of the core is now unsupported and falls into the parent roll-lifting device.

[0025] Figure 7 illustrates the parent roll lifting platform raised to a level where the crane mounted parent roll lifting device 59 can unload the core.

[0026] The center driven shuttle unwind parent roll change sequence which has been described above can be typical for all unwinds of this nature. In addition to the change sequence, different methods for parent roll support and for driving the parent roll can also be used. The parent roll support methods can be broken down into four categories. The first category, on-machine core chucks, requires the core chucks to be permanently fixed to the carriage. The core chucks can be stationary or mounted on a linear slide means. One advantage of mounting core chucks on linear slides is allowing for side shifting the parent roll in the chucking area. It also eliminates the requirement of handling core chucks.

Drive Combinations

[0027] The following drive combinations can be used for on-machine parent roll support methods. Figure 8 illustrates the one motor drive configuration of Figure 1 which switches the drive power from motor 40 between the parent roll stations as required. A prepping motor can be used to assist in splice preparation for this configuration.

[0028] Figure 10 illustrates a two motor configuration with the motors 66 and 67 located between the parent roll stations for driving the middle core chucks 34 and 35.

[0029] Figure 9 illustrates a two motor configuration with motors 64 and 65 located at the ends of the parent roll carriage 26 for driving the right and left core chucks 33 and 36. Figure 11 illustrates a three motor concept which includes motors 40 and 66 and 67. The center motor 40 uses the same drive mechanism as the side shuttle unwind with one drive motor shown in Figure 8. The web can be unwound clockwise as indicated at W_1, or counterclockwise as indicated at W_2 as shown in Figure 13.

[0030] Figure 13 illustrates the web travelling over upper and lower idler rolls 72 and 73 on the carriage 26 to a splicing apparatus 74. The splicing apparatus is described in detail in U. S. patent application entitled "Automatic Splicer for Unwinder," Serial No. 09/216,323, filed December 18, 1998. As described in said application, the leading end of the new web is spliced to the trailing end of the web of the expired roll.

Removable Core Chucks

[0031] The second category for parent roll support is removable core chuck methods. Removable core chucks are inserted into the side of the parent roll off-machine. A crane hooks the core chuck shafts and loads the parent roll into the carriage. A drive mechanism is then attached to the core chuck. The concept eliminates the requirement for the parent roll lift devices located on the carriage. It also eliminates the requirement of the crane-mounted parent roll handling device that has a powered adjustable span and replaces it with a standard hook.

[0032] Referring to Figure 14, removable core chucks

78 and 79 are inserted into the core of a new parent roll 31. Each core chuck includes a shaft 80 which is rotatably mounted in the housing 81 and a pulley 82 on the end of the shaft. The new parent roll is supported by a lift device 83 which includes hooks 84 for engaging the shafts.

[0033] As the new parent roll is lowered toward the carriage 26, the housings 81 engage the vertical support arms 38 and 39. The support arms can be provided with recesses for receiving the housings, or the housings can be clamped in place for a more secure mounting.

[0034] The core chucks 85 and 86 for the right parent roll 30 are clamped to the vertical support arms 38 and 39 by clamps 87 (see also Figure 15). Motors 88 and 89 are drivingly connected to the pulleys 82 by belts 90 and 91.

[0035] Figure 16 illustrates another embodiment of a removable core chuck 93 which includes a shaft 94 and a pulley 95. The shaft is rotatably mounted on, and clamped to, the carriage 26 by upper and lower bearings 96 and 97.

[0036] Figure 17 illustrates a drive system for rotating the removable core chucks. The shaft 99 of the core chuck is supported in a channel 100 on the support arm 38. The shaft is clamped in place by a clamp 101 which is pivotally mounted to the support arm by pin 102 which is pivoted by a piston 103.

[0037] A timing belt 104 extends around a drive motor pulley 105, a tension pulley 106, an idler pulley 107, and a hydraulic prepping motor pulley 108. The tension pulley 106 is mounted on a pivot arm 109 which is controlled by piston 110.

[0038] When the core chuck is clamped in place, the pulley 111 of the core chuck is aligned with the belt 104. The tension pulley 106 is pivoted to engage the belt with the pulley. The parent roll can be rotated slowly for splice preparation by activating the hydraulic prepping motor which drives the pulley 108. The parent roll can be rotated for unwinding the web by activating the drive motor for the pulley 105.

[0039] In the embodiment illustrated in Figure 17, the belt 104 also wraps a brake pulley 112 which is mounted on a disc brake 113. The disc brake rotates between brake pads 114, and rotation of the parent roll can be stopped by activating the brake pads to clamp the disc brake.

[0040] All of the drive motor configurations which were described in Figures 1-13 for the on-machine core chucks can also be used for the removable core chucks.

Removable Core Chucks With <u>On-Machine Shafts</u>

[0041] A third parent roll support category uses removable core chucks and rotating shafts which are permanently mounted on the unwinder. This category allows for side shifting the parent roll at the core chuck locations. It also eliminates the requirement for the parent roll lifting device of Figures 1-13 and replaces it with a standard hook.

[0042] Referring to Figures 18-20, removable core chucks 117 and 118 are inserted into right parent roll 30 and removable core chucks 119 and 120 are inserted into left parent roll 31. Each core chuck includes a head 121 which is inserted into the core of the parent roll and a hollow tapered tube 122.

[0043] In Figure 19 the left parent roll 31 is being lowered toward the carriage 26 by a lift device 123 which includes hooks 124 which engage the tubes 122 of the core chucks. The parent roll is lowered until the tubes 122 are supported by chuck rests 125 on the carriage.

[0044] Referring to Figure 20, each core chuck is engageable to a shaft 126 which is rotatably mounted by bearings within a housing 127 which is mounted on the carriage. The housing 127 is slidably mounted for axial movement on a slide 128, and the housing is moved axially by an axial drive device 129. A pulley 130 on the end of the shaft is driven by a motor 131. After the parent roll is lowered to the chuck rests 125, the housings 127 are moved axially to insert the shafts 126 into the tubes 122 of the core chucks. The end of each shaft is tapered and engages a correspondingly shaped bore in the tube to provide a non-rotating fit.

<u>Parent Roll With Center Shaft</u>

[0045] The fourth parent roll support category uses the center shaft around which the web is wound by the paper machine for forming the parent roll. In Figure 21 parent rolls 134 and 135 were formed by a paper machine by winding a web around center shafts 136 and 137. The center shafts are conventional and well known. Referring to Figure 23, each end of each shaft includes a collar 138 which is rotatably mounted on the shaft and a radially enlarged drum 139 which is fixed to the shaft. The shaft terminates in an end journal 140.

[0046] The collars 138 on the ends of the shaft are supported by support arms 141 and 142 on the carriage 26. The end journal on one end of the shaft is engageable with a low backlash coupler 143 on a shaft 144. A pulley 145 on the shaft is driven by a motor 146 which is mounted on a slide 147 for axial sliding movement. Rotation of the shaft can be stopped by brake 148. A hydraulic cylinder 149 moves the motor axially. The motor 146 can be shifted axially for driving either of the parent rolls.

[0047] Each parent roll can be rotated slowly for splice preparation by a prepping motor 150 on one of the support arms 141 and 142. A rubber tire or wheel 151 is driven by the motor, and the motor and tire can be pivoted by a hydraulic cylinder 152 so that the tire engages the drum 139 on the center shaft. The drum can also be used as a brake drum for stopping the parent roll or for holding it in place after splice preparation. The motor 146 can be shifted axially for driving either of the parent rolls.

[0048] Figure 22 illustrates the right parent roll 134

being rotated by the motor 146 as the left parent roll is being loaded by lift device 154. Figure 21 shows the left parent roll supported on the carriage.

[0049] While in the foregoing specification a detail description of specific embodiments of the invention was set forth for the purpose of illustration, it will be understood that many of the details hereingiven can be varied considerably by those skilled in the art without departing from the spirit and scope of the invention.

Claims

1. An apparatus for alternately unwinding a web from first and second parent rolls comprising:

   a carriage for supporting a pair of parent rolls, each of the parent rolls having an axially extending center and web material wound around the center, the carriage being axially movable between a first position in which the first parent roll is in an unwinding position and the second parent roll is in a loading position and a second position in which the second parent roll is in an unwinding position and the first parent roll is in a loading position, and
   first and second center drive mechanisms mounted on the carriage, the first drive mechanism being engageable with the center of the first parent roll when the first parent roll is in the unwinding position for rotating the first parent roll, the second drive mechanism being engageable with the center of the second parent roll when the second parent roll is in the unwinding position for rotating the second parent roll.

2. The apparatus of claim 1 in which each of the first and second drive mechanisms includes a pair of core chucks which are removably engageable with the center of one of the parent rolls.

3. The apparatus of claim 2 in which each of the core chucks is rotatably mounted on the carriage.

4. The apparatus of claim 3 in which one of the core chucks of each of the first and second drive mechanisms is mounted on the carriage for axial movement.

5. The apparatus of claim 2 including a motor and means for alternately connecting the motor to one of the core chucks of each of the first and second drive mechanisms.

6. The apparatus of claim 2 in which each of the first and second drive mechanisms includes a motor for rotating one of the core chucks of the drive mechanism.

7. The apparatus of claim 6 including a third motor and means for alternately connecting the third motor to the other core chuck of each of the drive mechanisms.

8. The apparatus of claim 2 in which each of the first and second drive mechanisms includes a pair of motors for rotating the core chucks of the drive mechanism.

9. The apparatus of claim 2 in which each of the first and second drive mechanisms includes a shaft for each of the core chucks which is removably engageable with the core chuck, each of the shafts being rotatably mounted on the carriage.

10. The apparatus of claim 9 in which at least one of the shafts of each of the drive mechanisms is axially movable on the carriage.

11. The apparatus of claim 2 in which each of the core chucks includes a shaft which is attached to the core chuck, each of the shafts being removably and rotatably mounted on the carriage.

12. The apparatus of claim 11 including a housing rotatably mounted on each of the shafts and means for removably mounting each of the housings on the carriage.

13. The apparatus of claim 11 including bearings on the carriage for rotatably supporting each of hte shafts.

14. The apparatus of claim 1 including a lift mechanism on the carriage for each of the parent rolls, each lift mechanism being movable between lowered and raised positions.

15. The apparatus of claim 2 in which each of the first and second drive mechanisms includes a pair of shafts which are operatively connected to the core chucks, a shaft pulley mounted on one of the shafts, a drive motor pulley rotatably mounted on the carriage, and a drive belt entrained around the drive motor pulley and the shaft pulley.

16. The apparatus of claim 15 in which each of the first and second drive mechanisms includes a tension pulley movably mounted on the carriage and engageable with the drive belt for drivingly engaging the drive belt with the drive motor pulley and the shaft pulley.

17. The apparatus of claim 15 in which each of the first and second drive mechanisms includes a prepping motor and a prepping motor pulley, the drive belt being entrained around the prepping motor pulley.

18. The apparatus of claim 15 in which each of the first and second drive mechanisms includes a brake pulley rotatably mounted on the carriage which engages the drive belt and means for preventing rotation of the brake pulley.

19. The apparatus of claim 1 in which each of the parent rolls includes a center shaft, each of the first and second center drive mechanisms being engageable with the center shaft of one of the parent rolls.

FIG.1

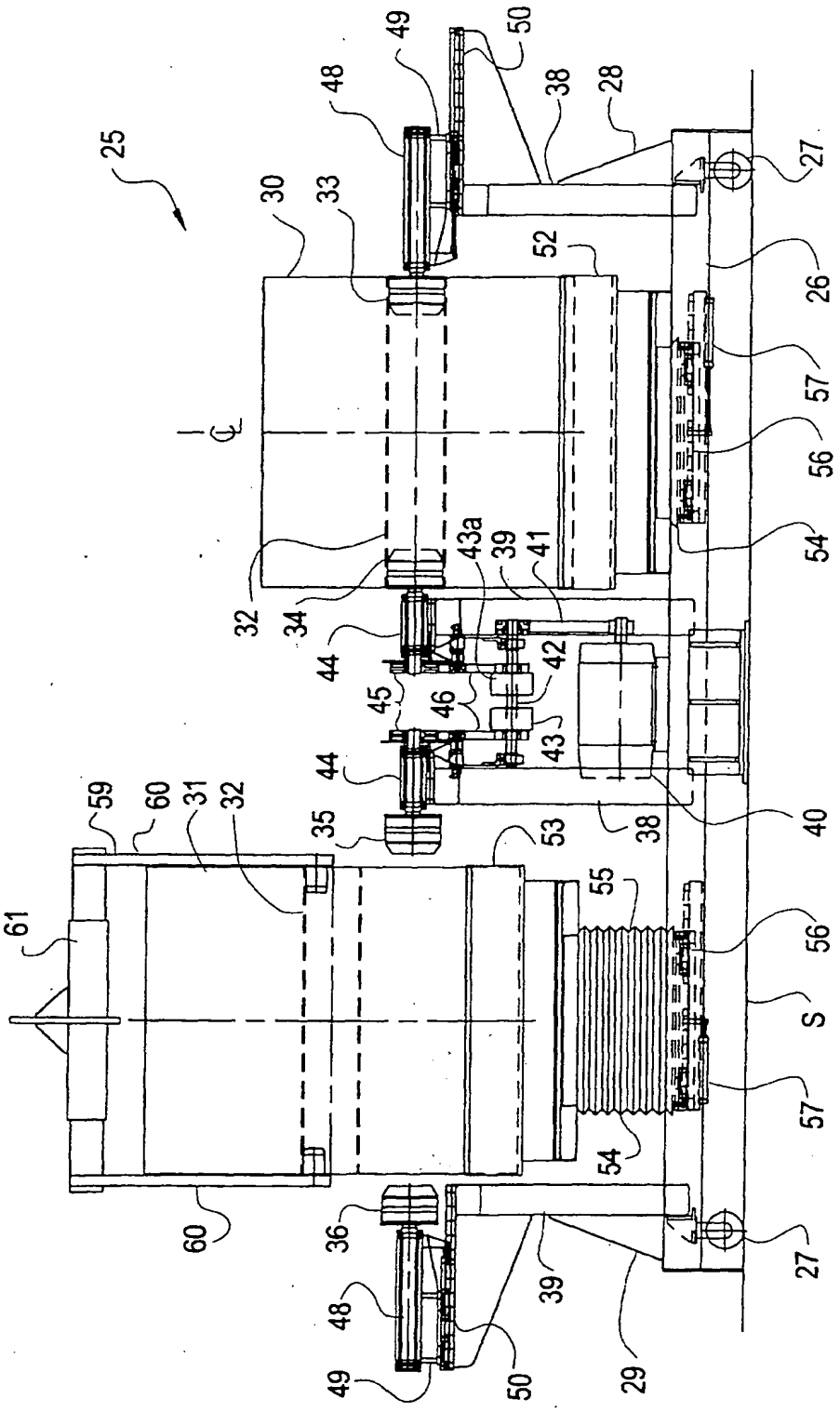

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FIG.2

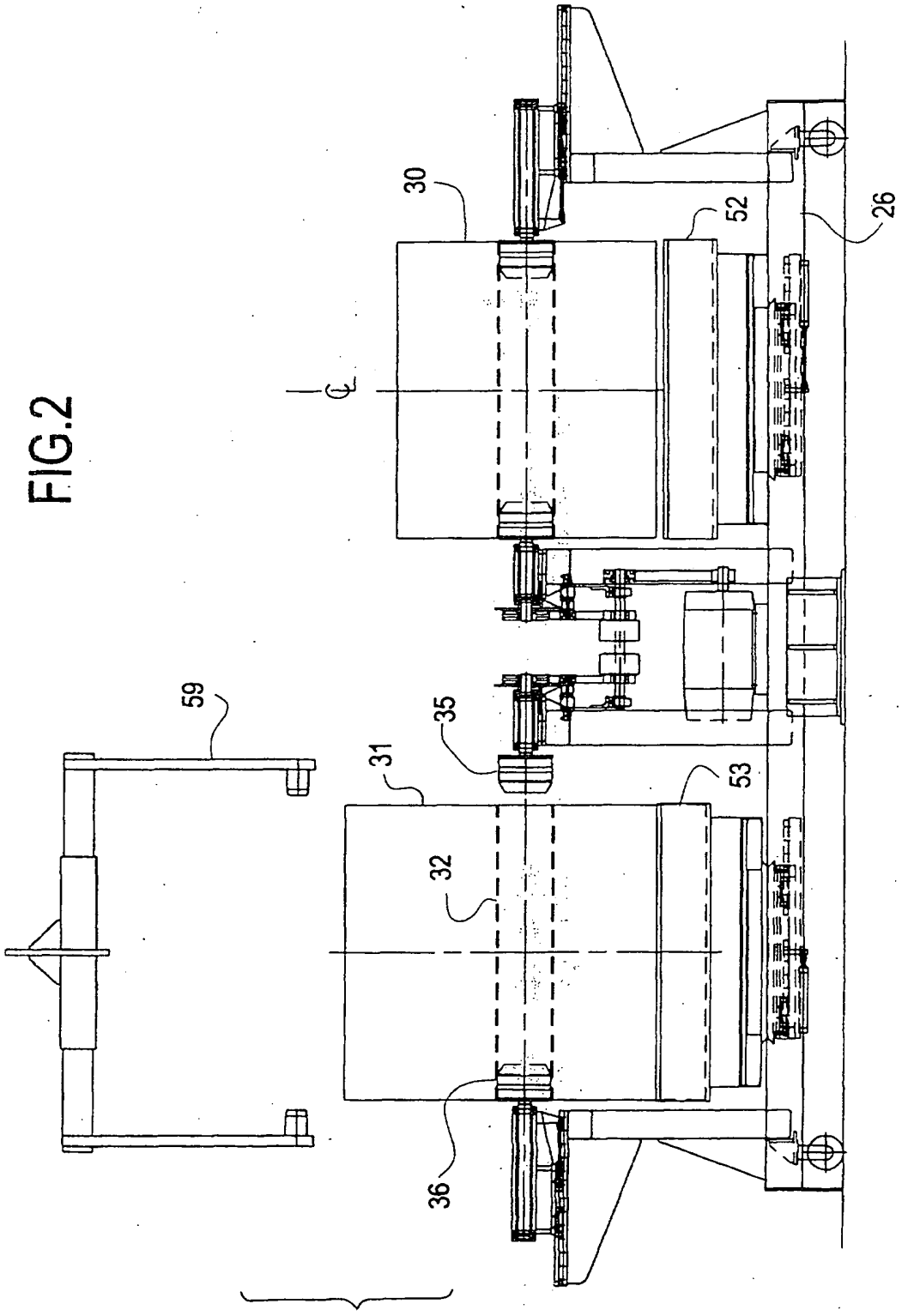
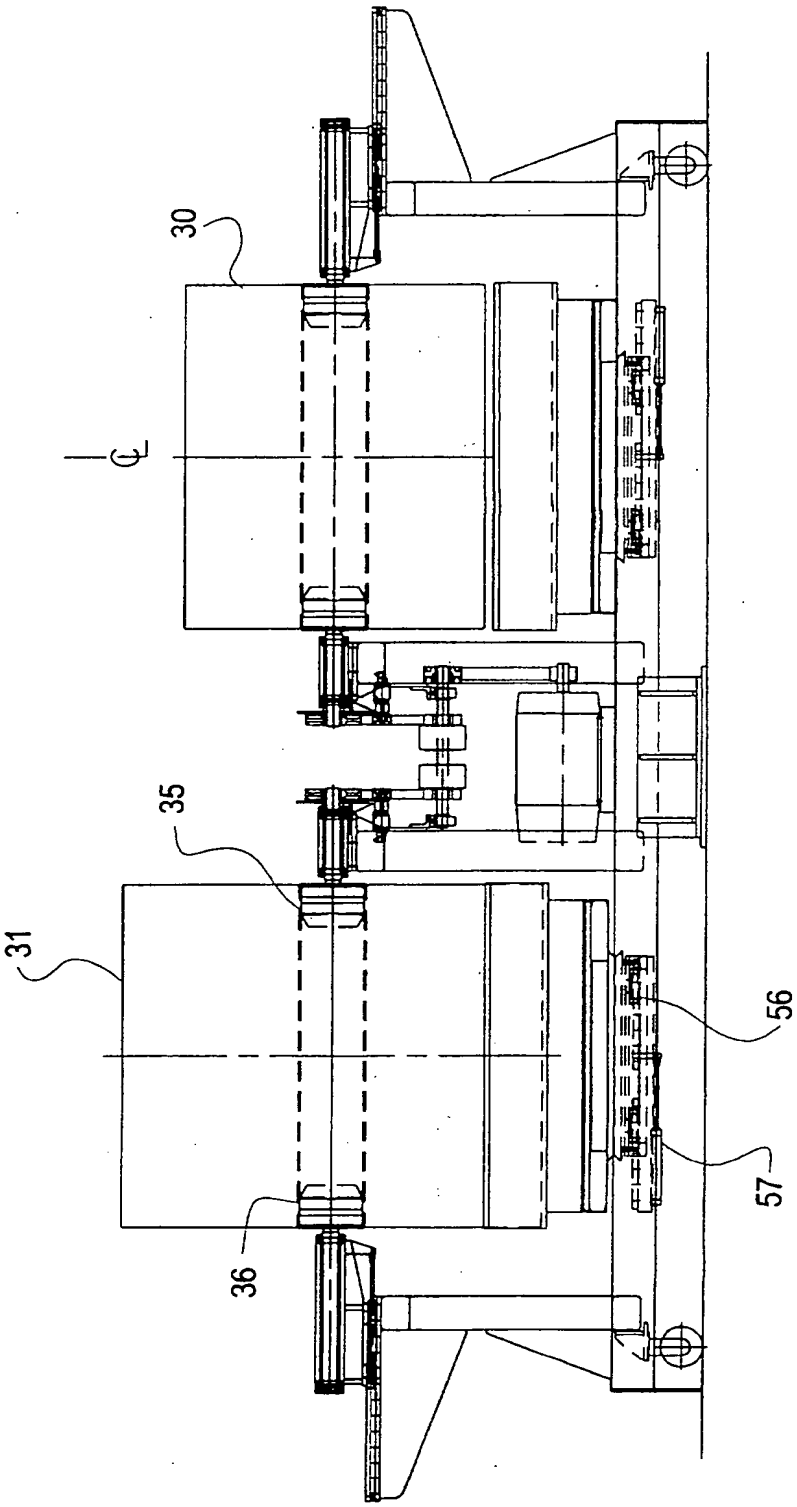


FIG.3



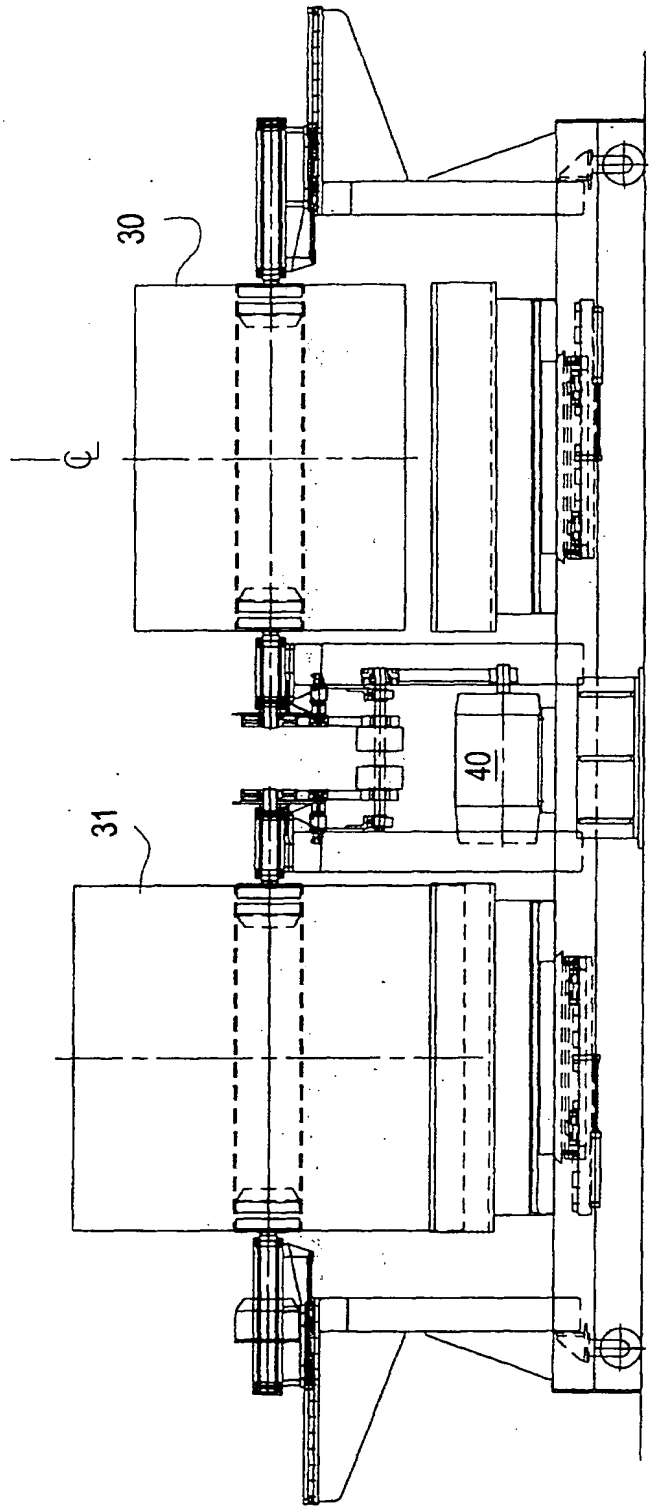


FIG.4

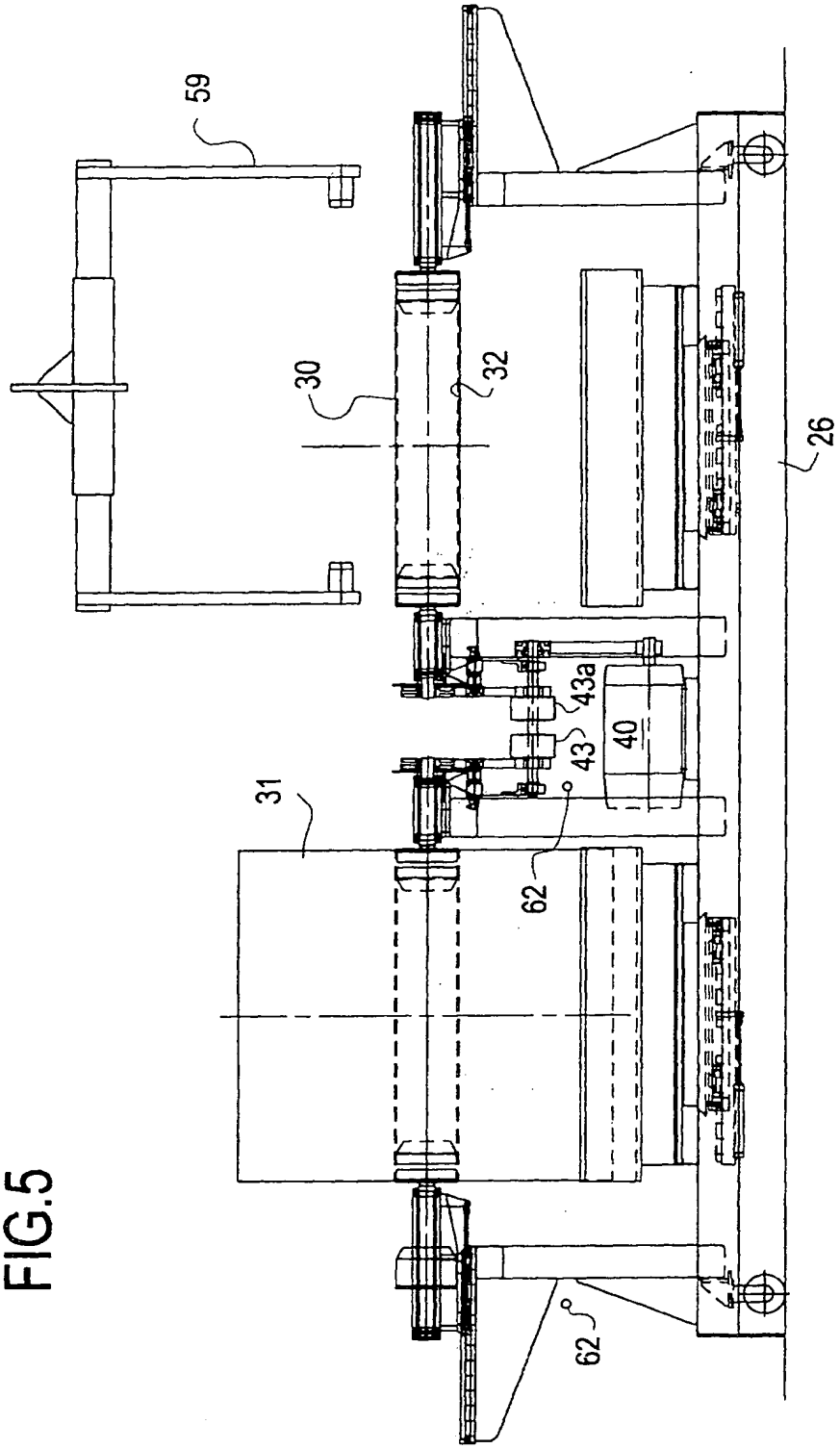


FIG.5

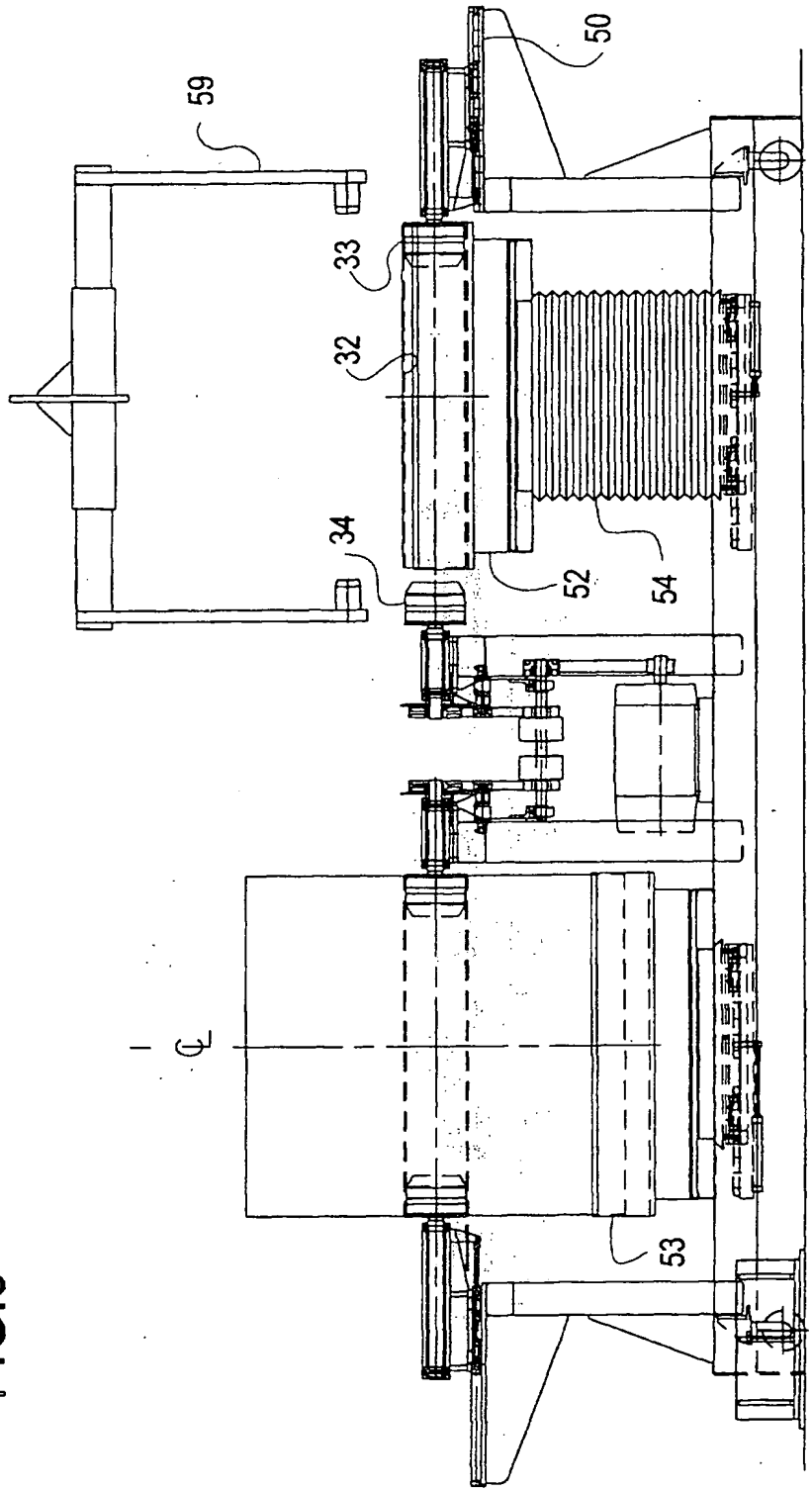


FIG.6

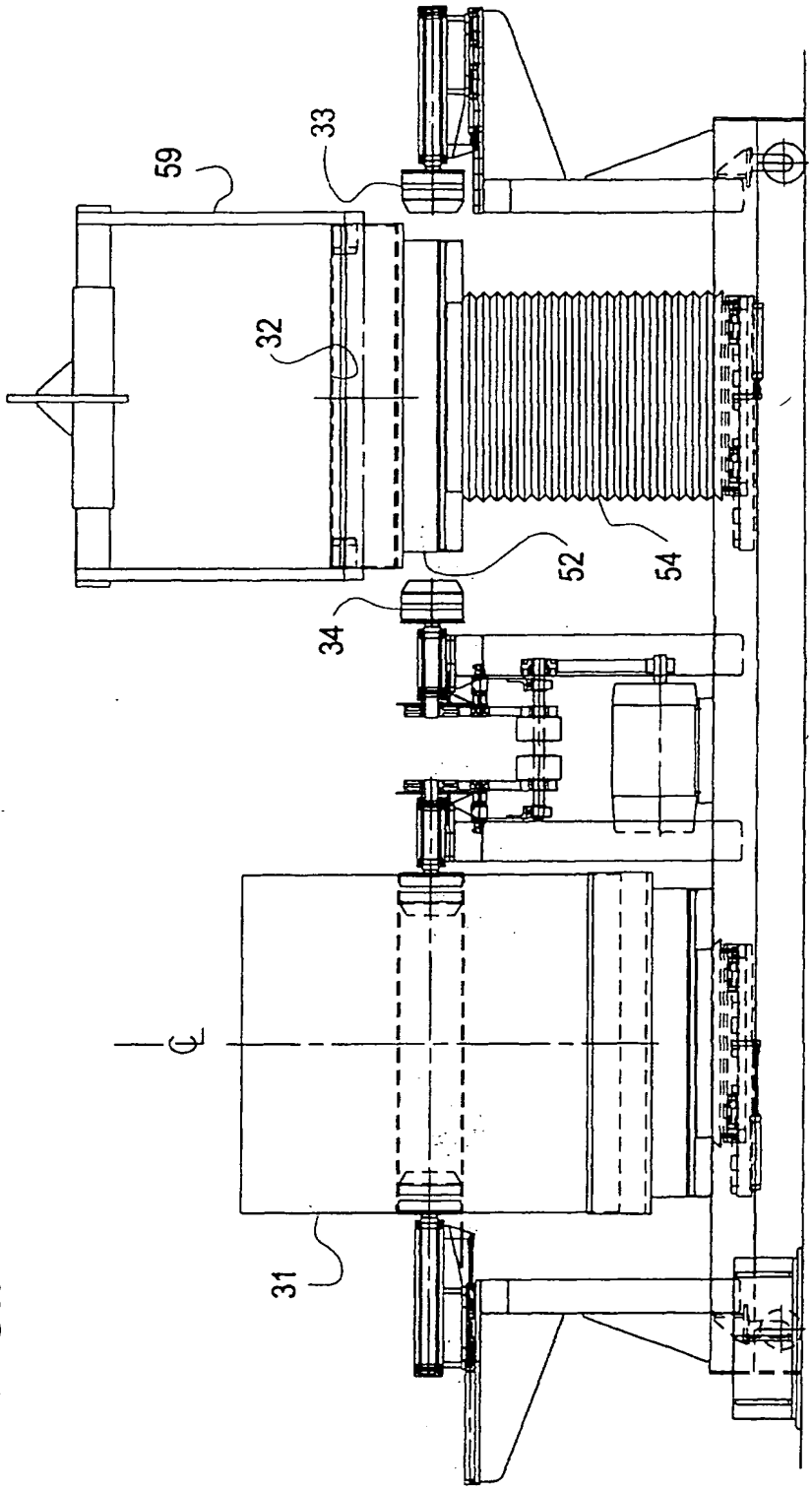


FIG.7

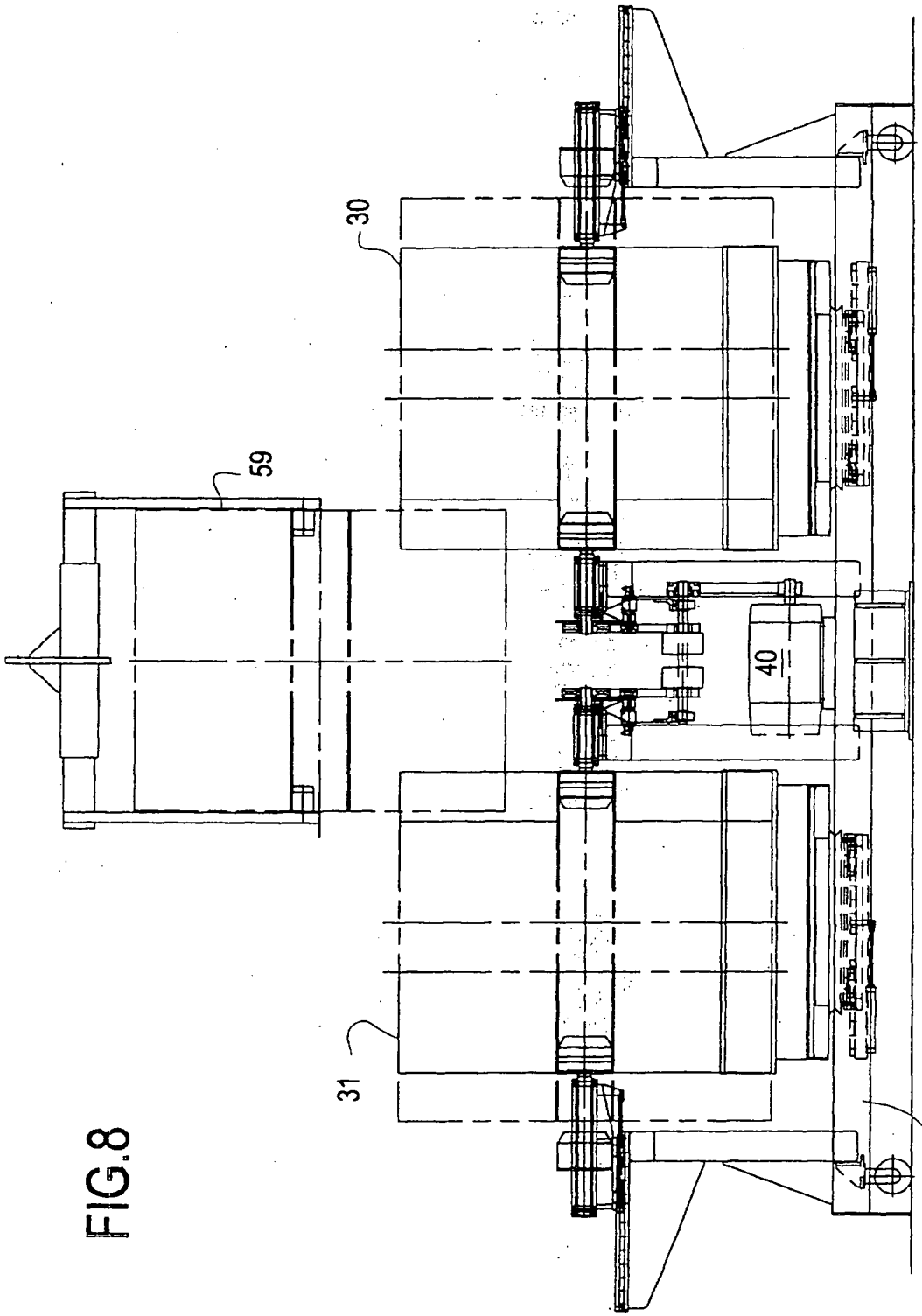


FIG.8

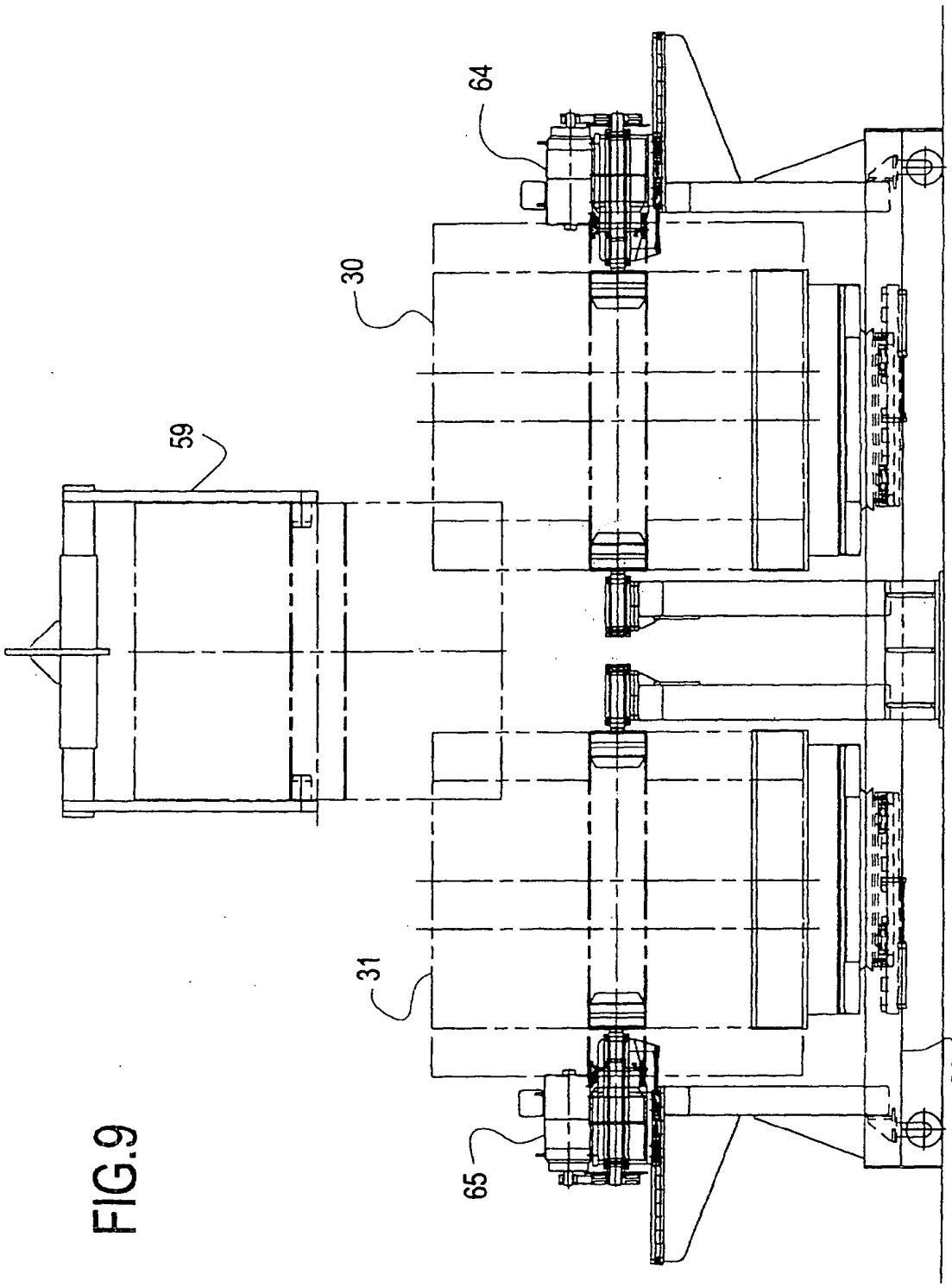


FIG.9

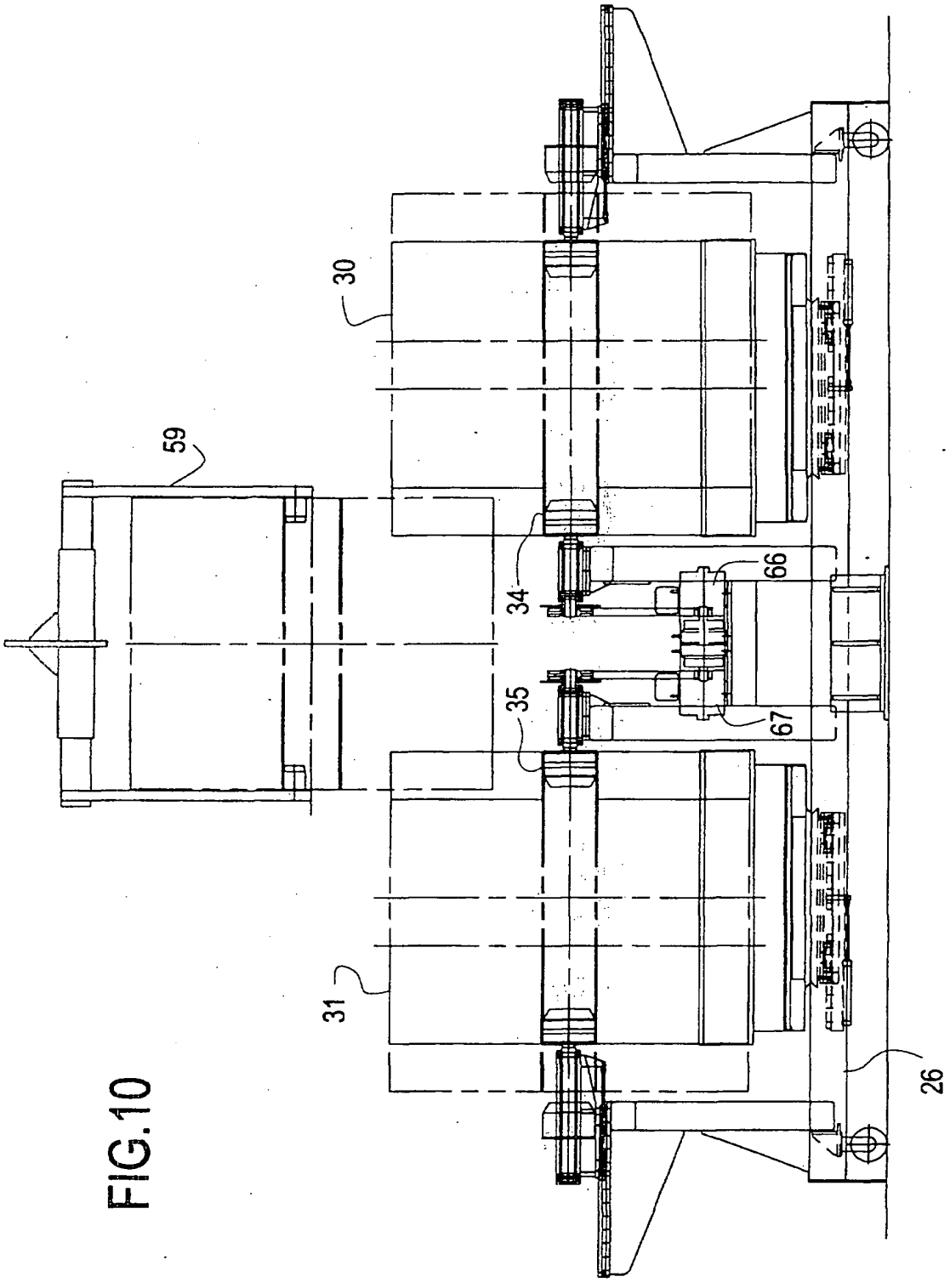


FIG.10

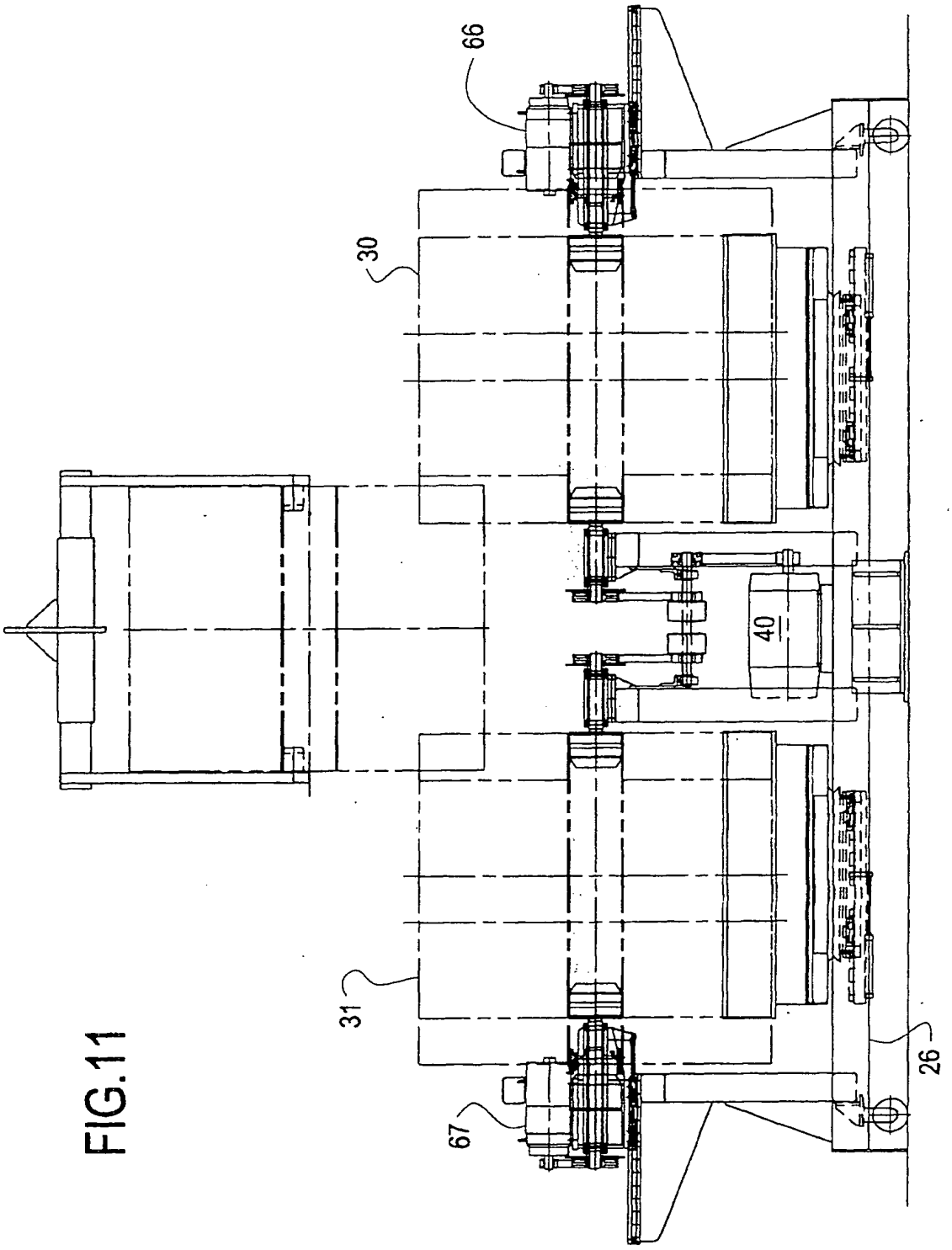


FIG.11

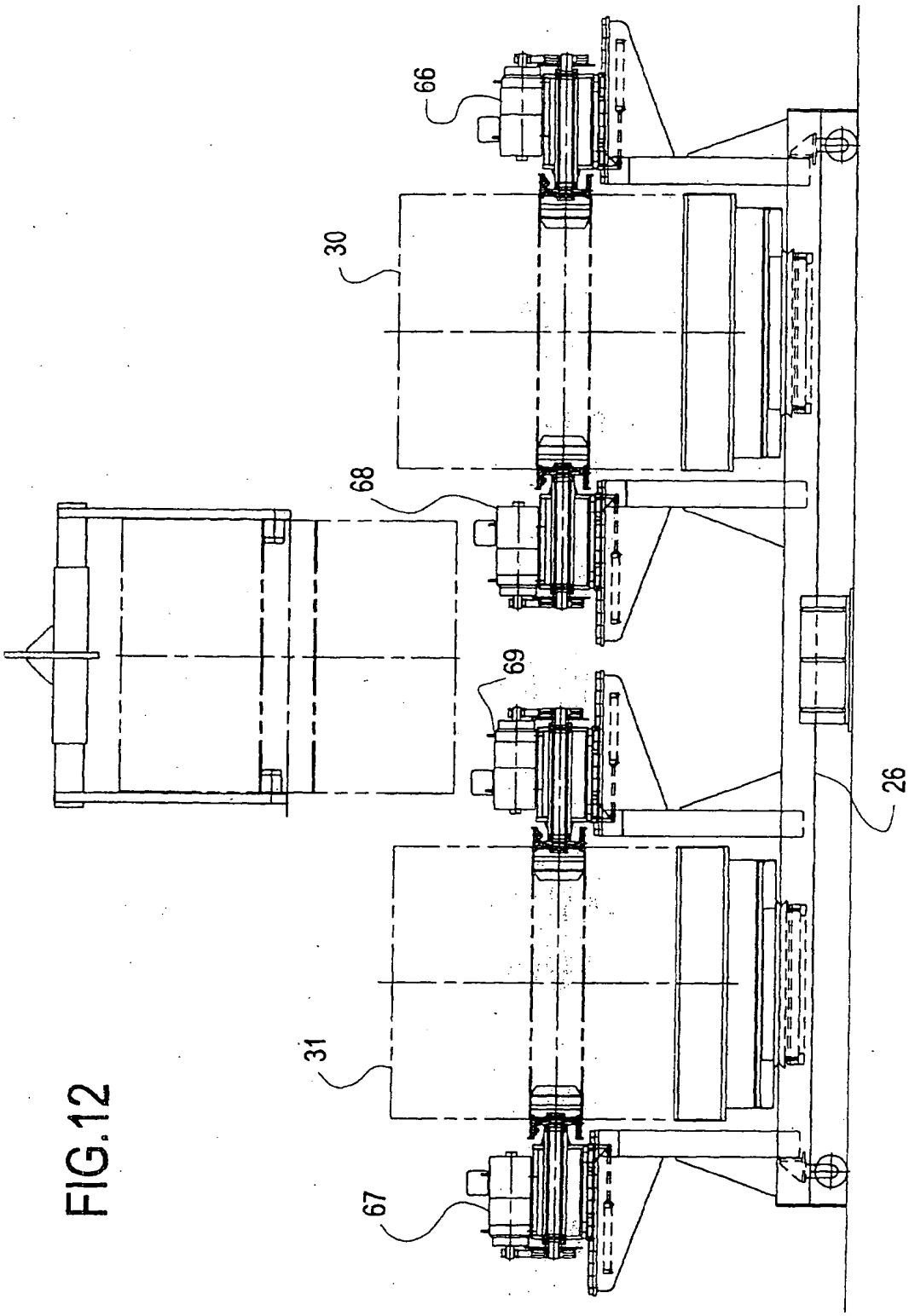


FIG.12

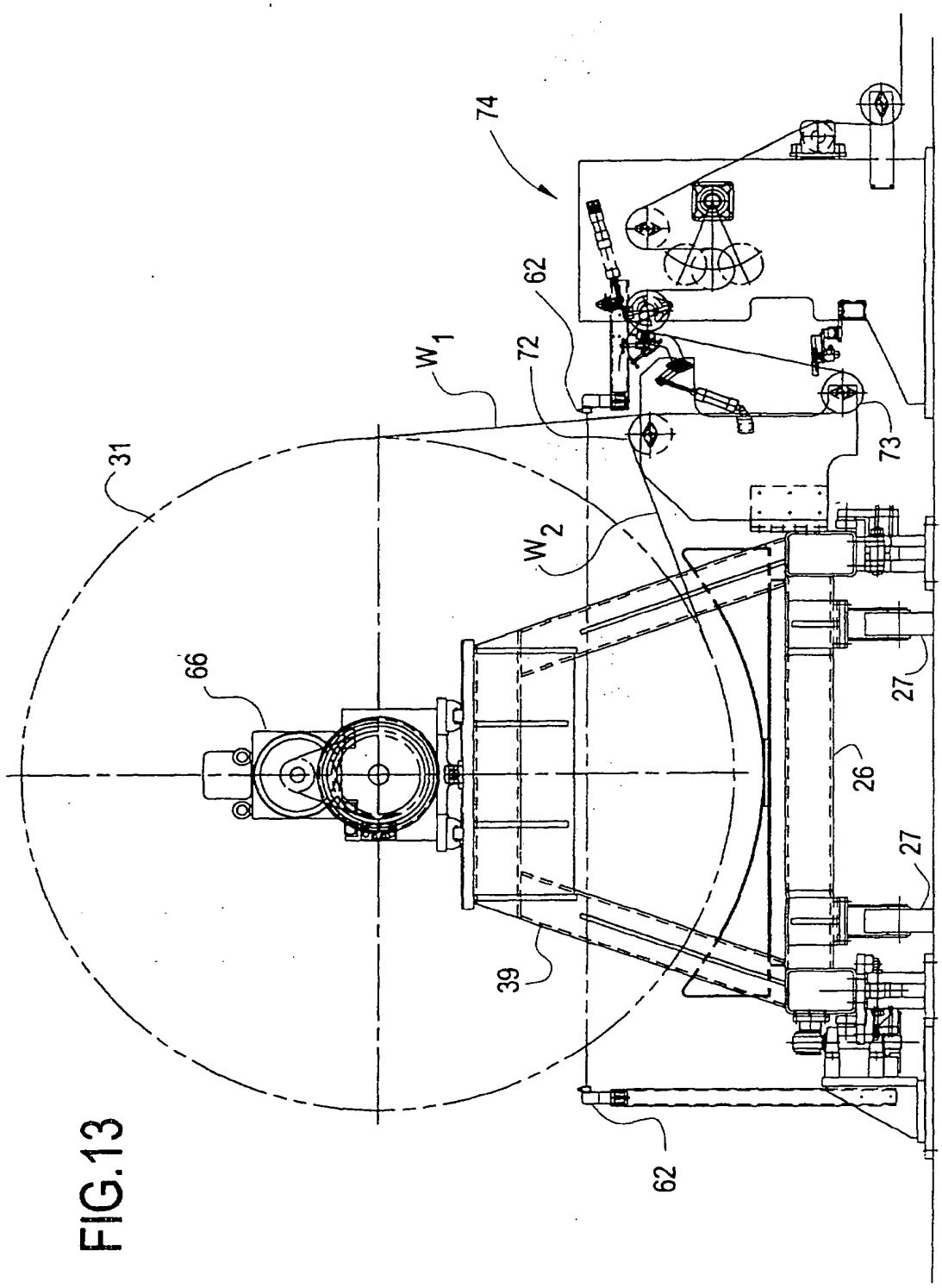


FIG.13

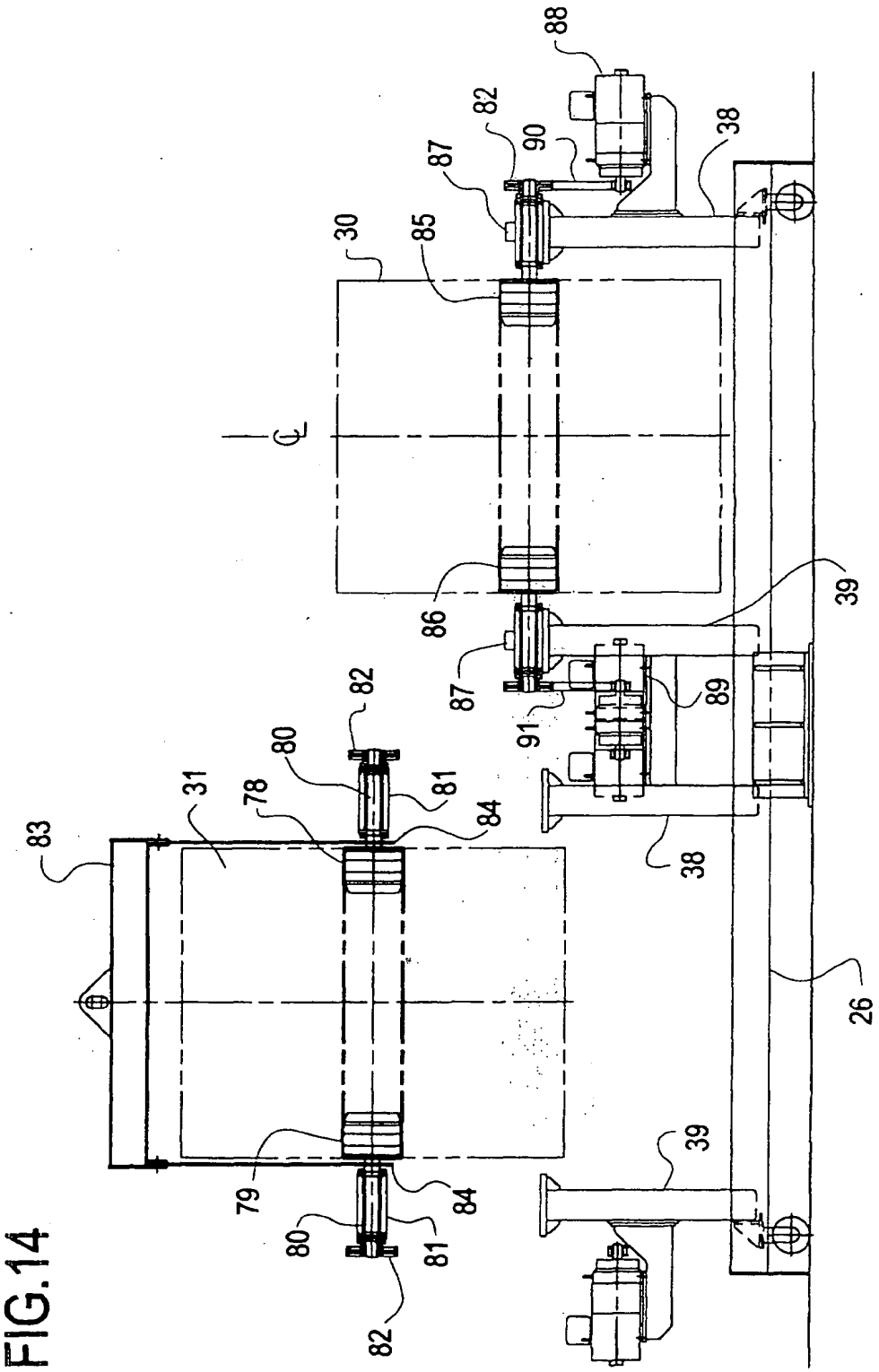


FIG.14

FIG.15

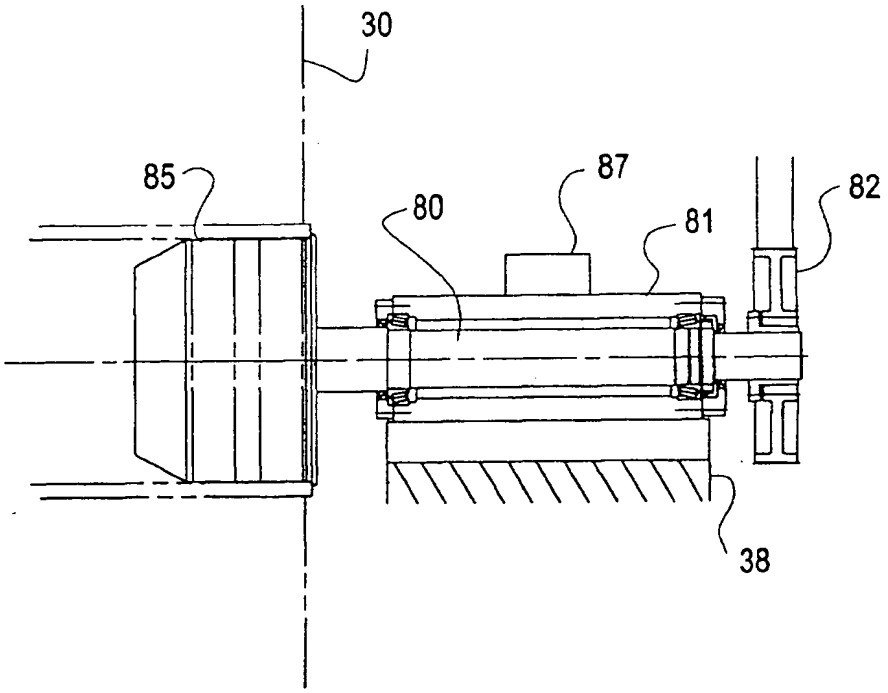
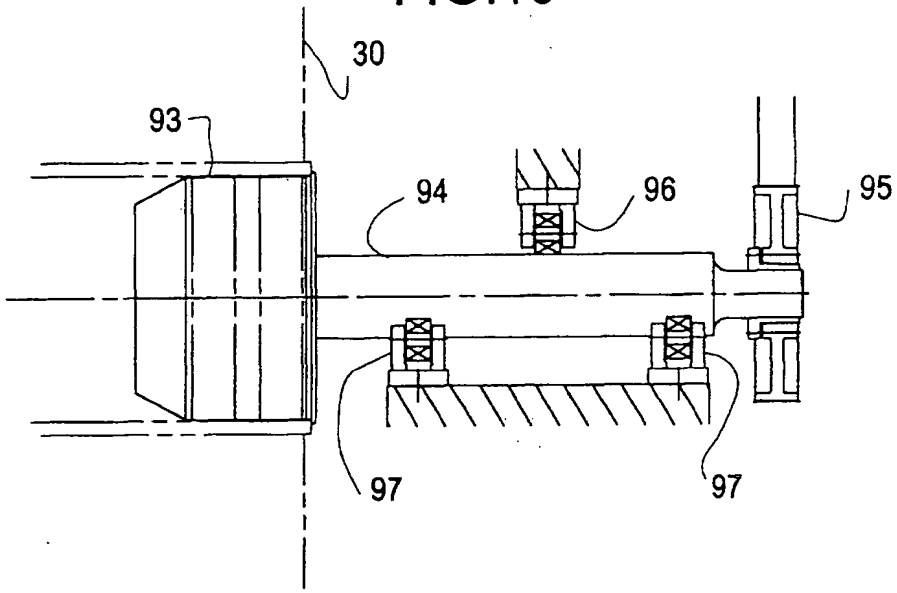


FIG.16



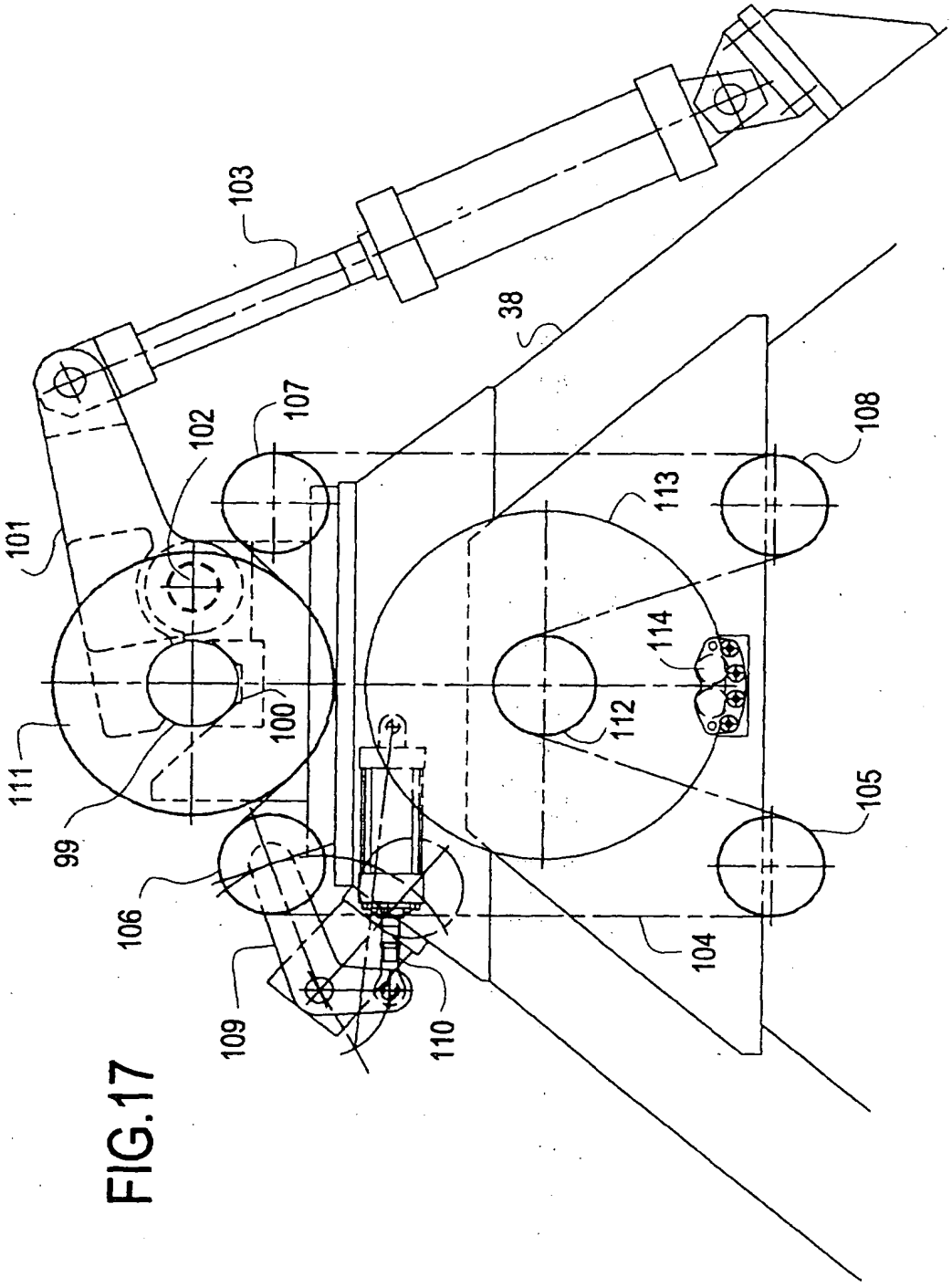


FIG.17

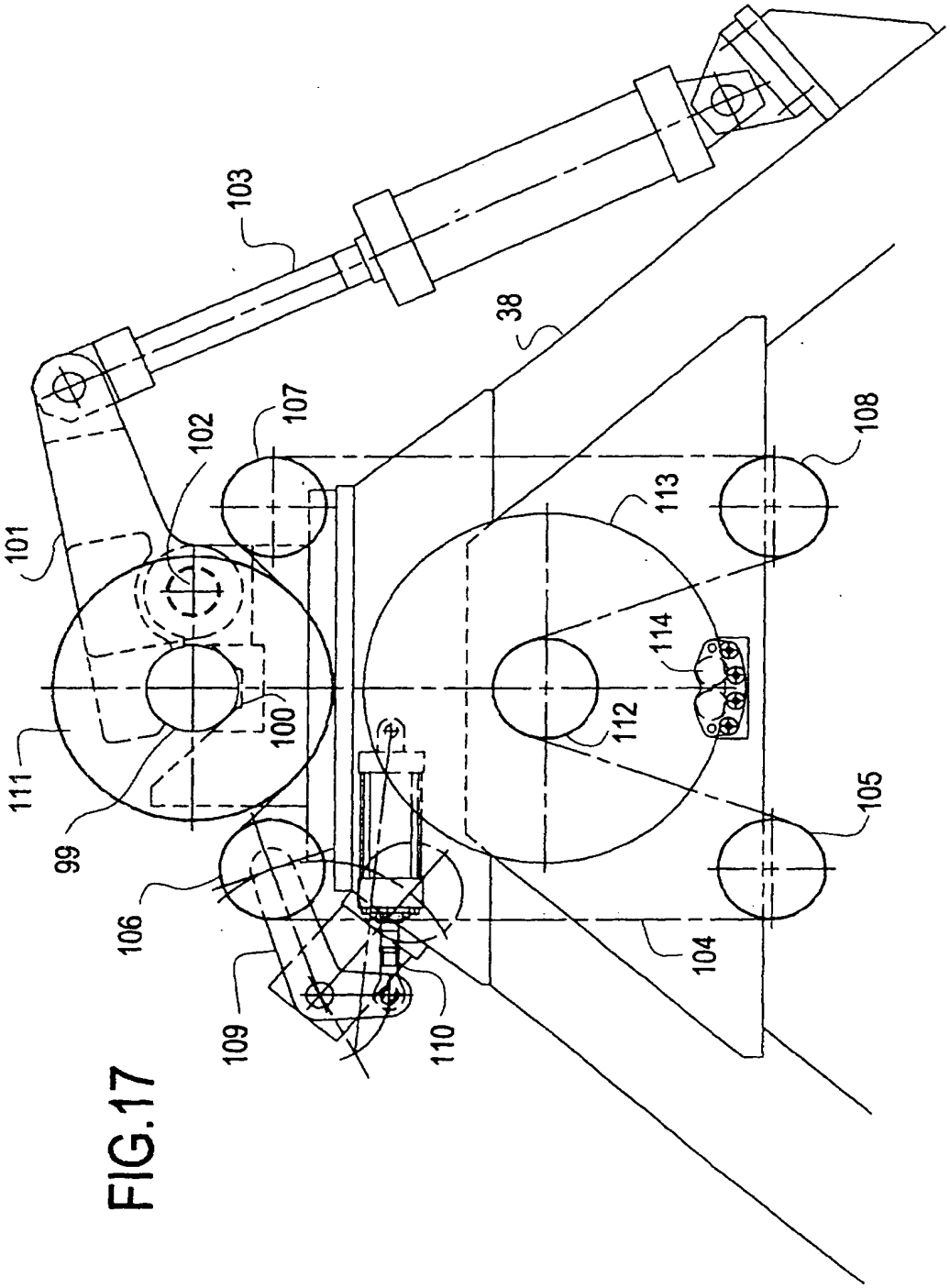


FIG.17

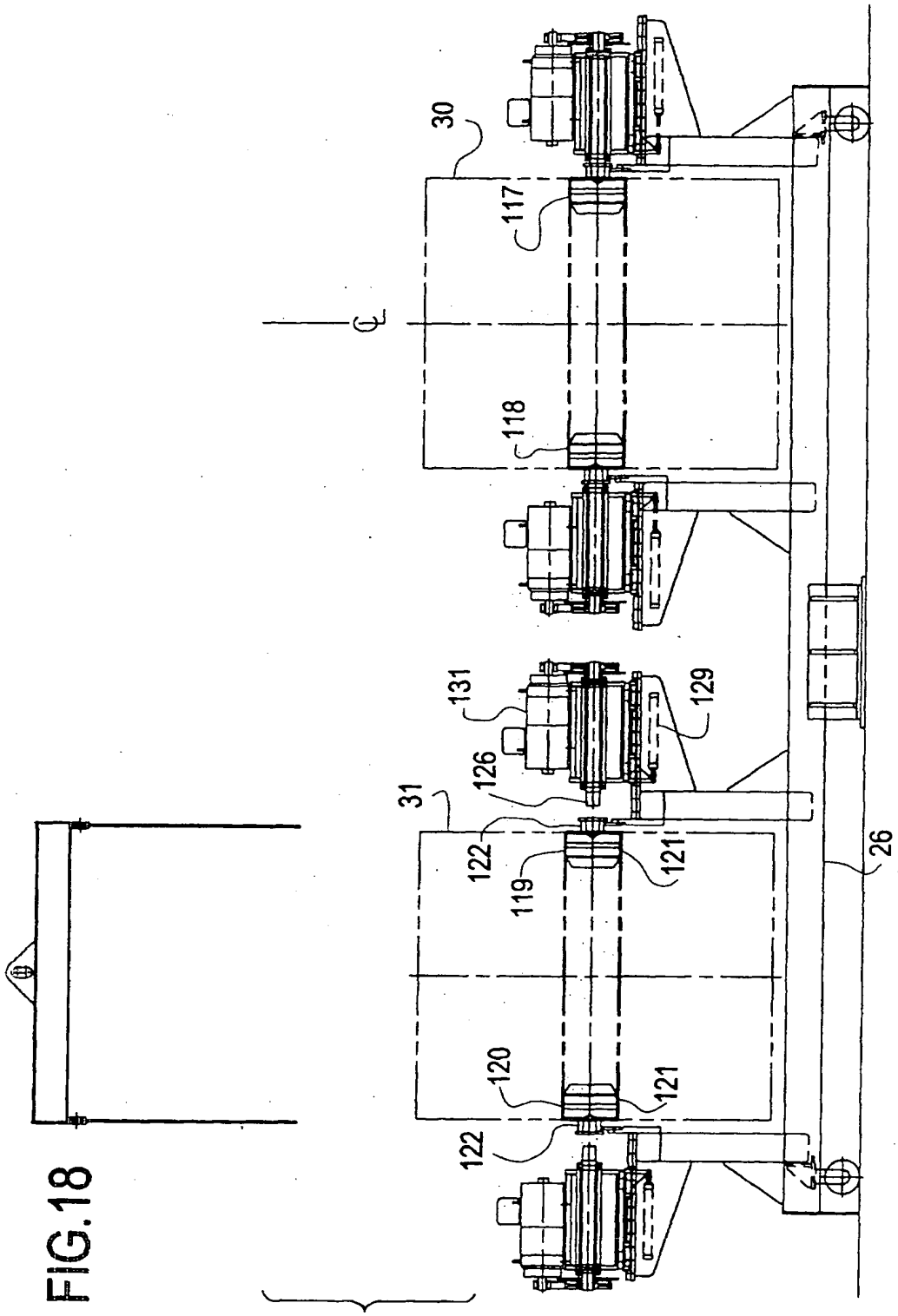
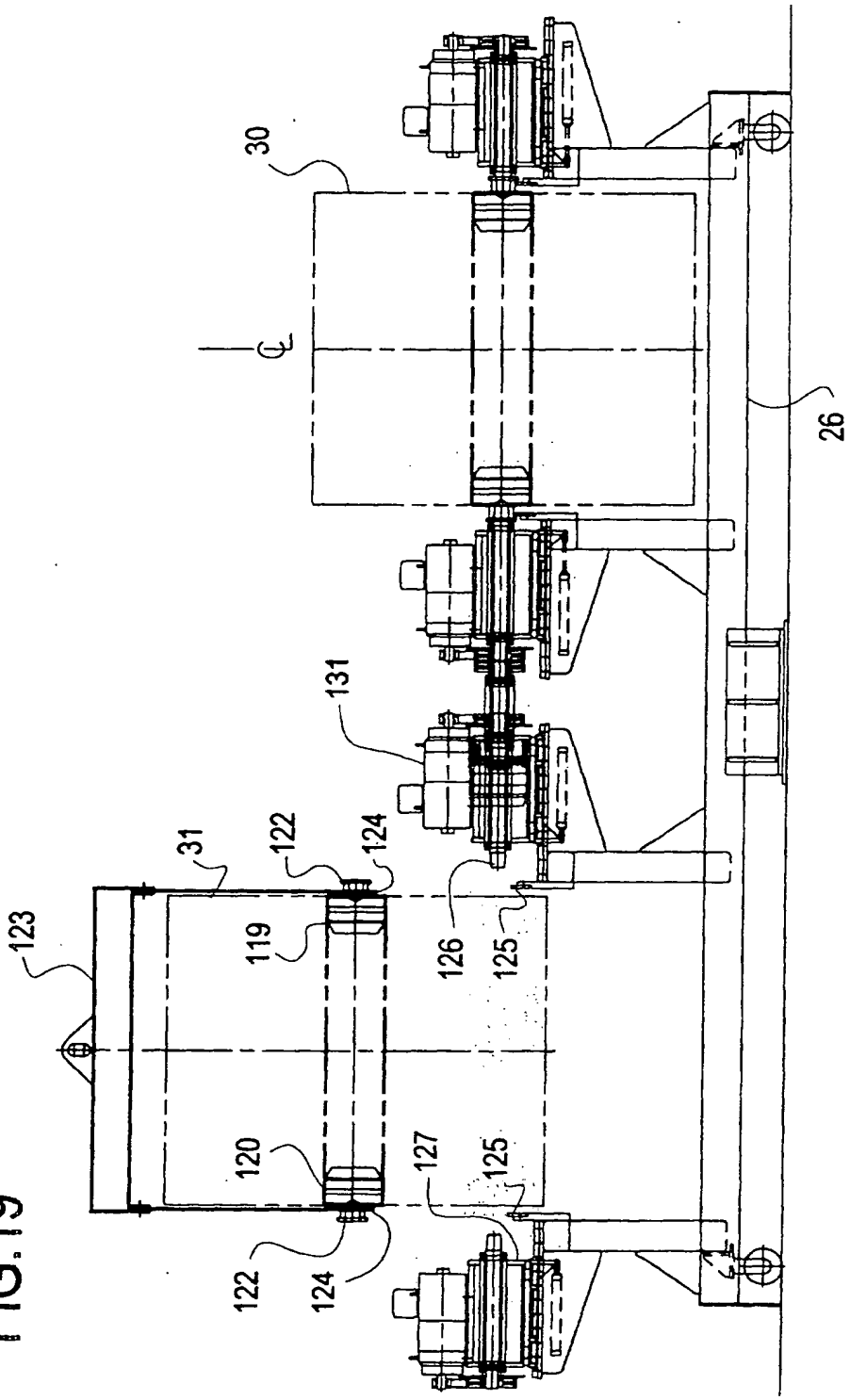


FIG.18

FIG.19



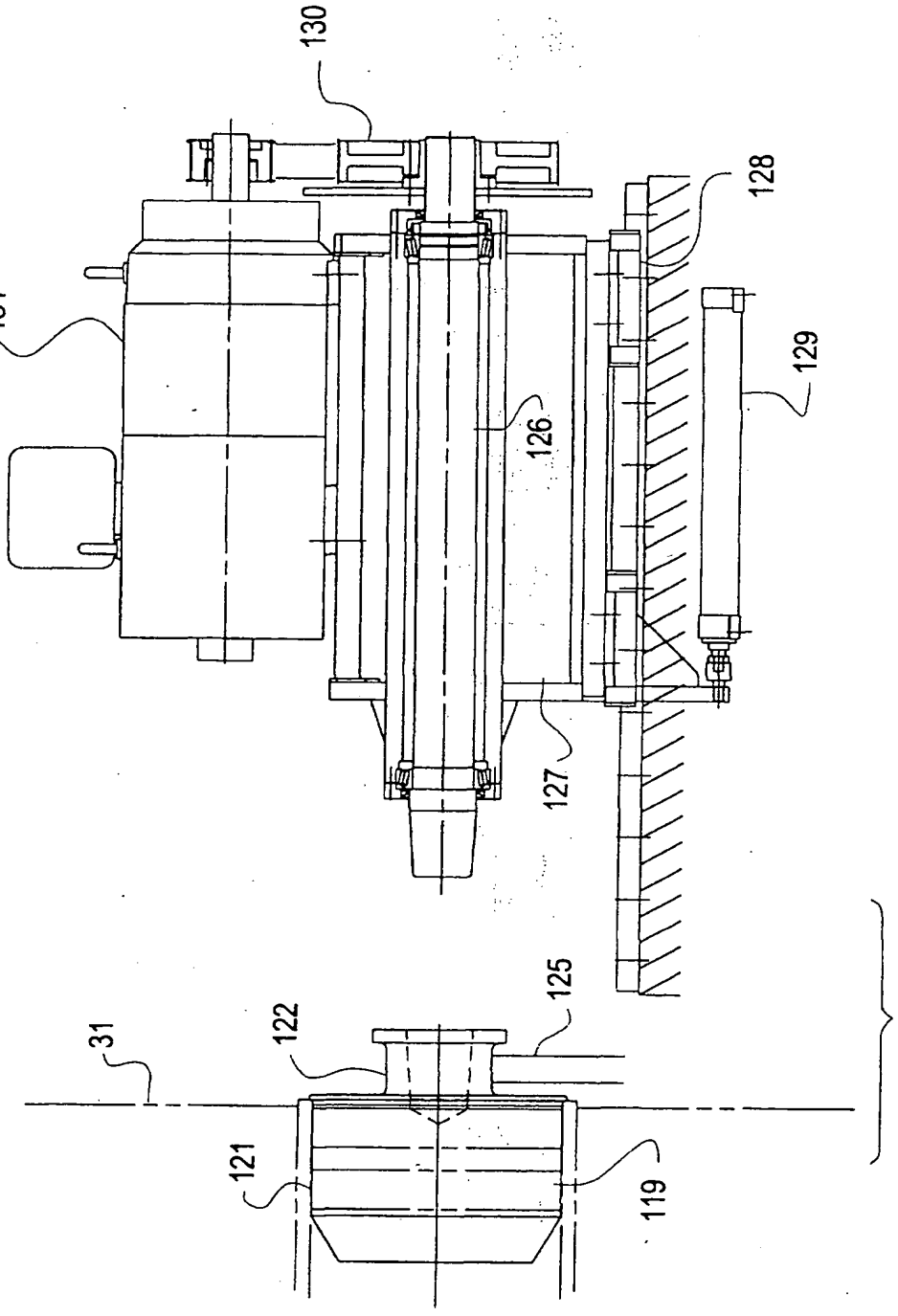


FIG.20

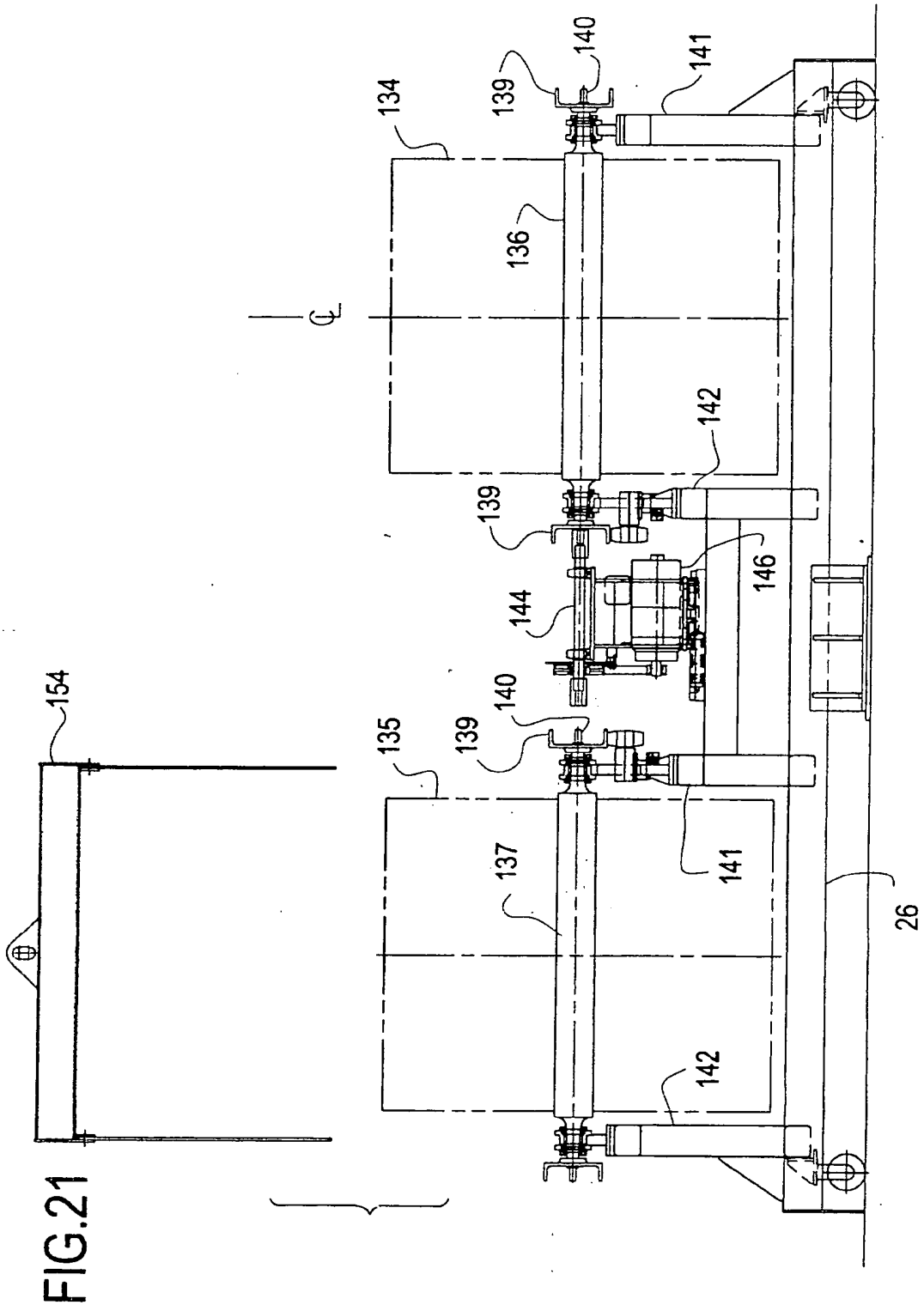


FIG.21

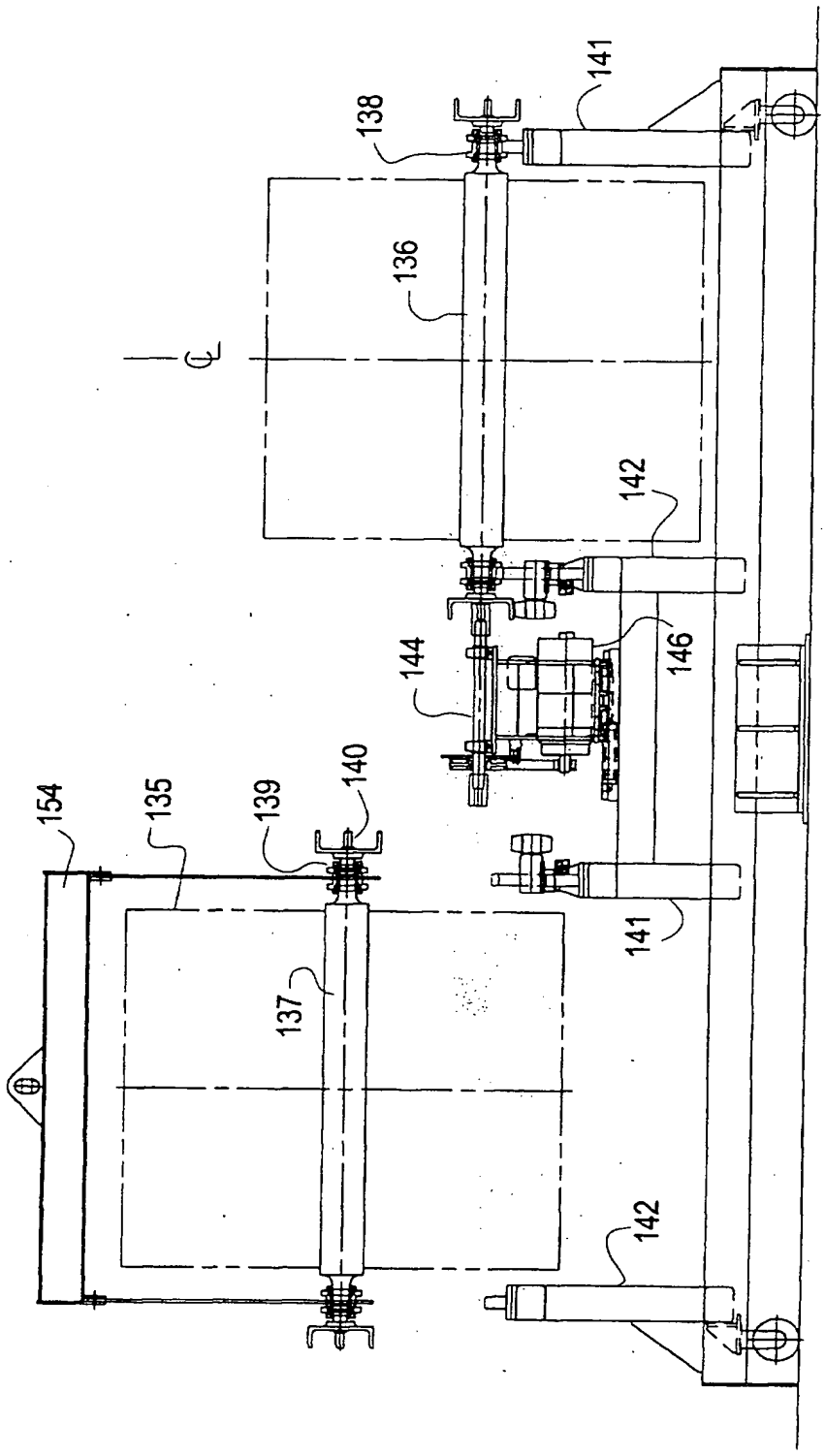
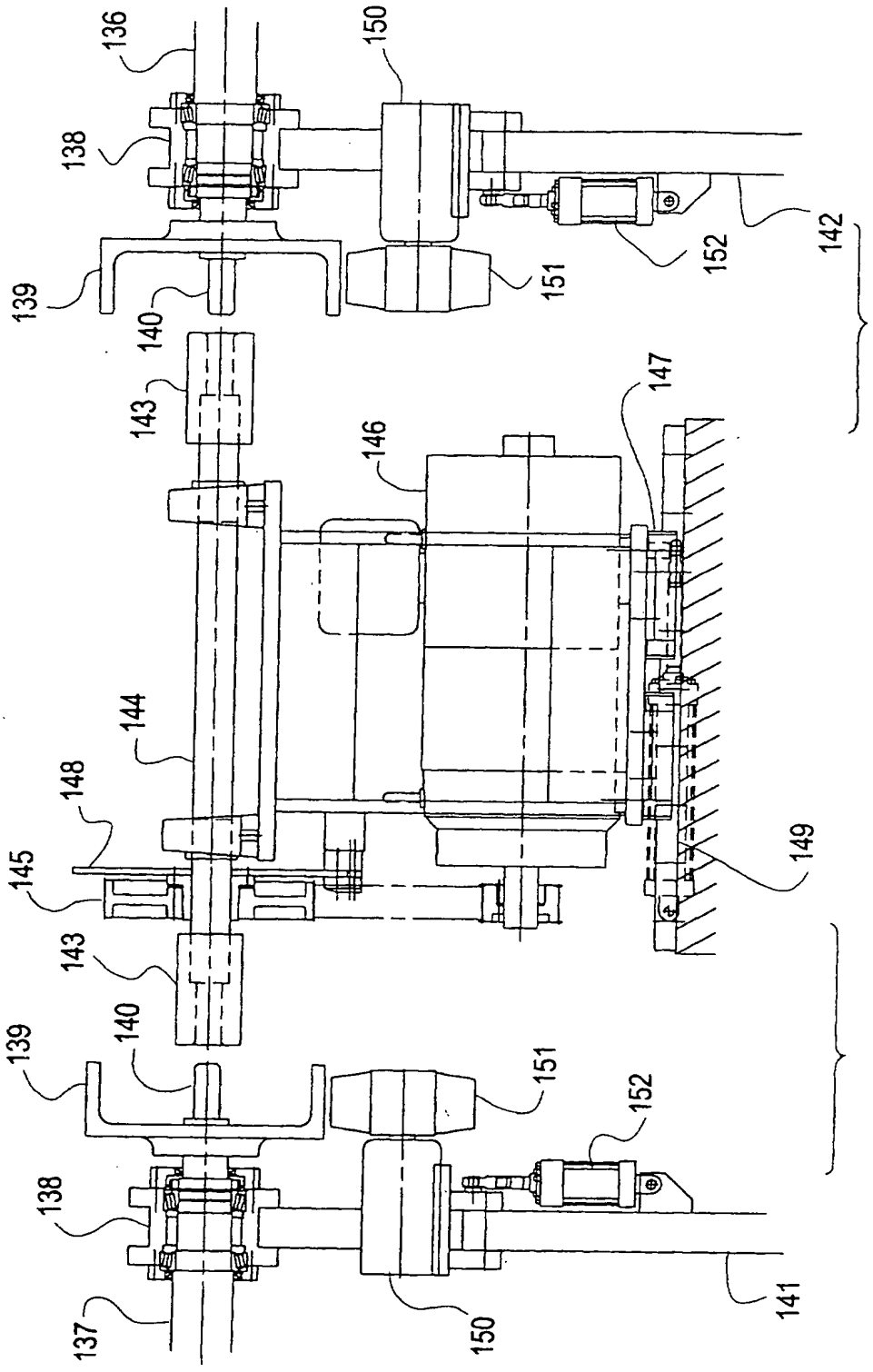


FIG.22

FIG.23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